in form of dust in the air causes a considerable cellular proliferation with development of pneumosclerotic foci. The maximum permissible concentration of niobium nitride in the air is suggested to be set at a level of 10 mg/m^3.

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MAXIMUM PERMISSIBLE CONCENTRATION OF PHTHALOPHOS IN AIR OF WORKING ZONE

(K obosnovaniyu predel'no dopustimoi kontsentratsii flalofosa v vozdukhe rabochei zony)

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The new insecticide and acaricide phthalophos (0.0-dimethyl-phthalimidiomethyl-dithiophosphate), which is synthesized at the All-Union Research Institute of Chemical Means for Plant Protection, is an organophosphorus compound. Chemically pure phthalophos is a white crystalline solid, soluble in organic solvents and oils, but practically insoluble in water. It is hydrolized to the extent of 50% in less than 4 hr at pH 8.3, in 12 hr at pH 7.0, and in 30 days at pH 4.5. It is used in agriculture, including animal husbandry, as an efficient combined insecticide-acaricide. It is sold as a 20% emulsion and a 30% wettable powder. It is used for spraying in 0.02—0.1% aqueous emulsions.

The Soviet literature provides no information on the toxicity of phthalophos. Isolated reports on the toxicity of its analog imidane have been published outside the USSR. According to Menn and McBrain, the median lethal dose (LD_{50}) of imidane for albino rats is 220 mg/kg; according to data published by the Stauffer Company (USA) which manufactures the preparation, the LD_{50} of imidane is 233 mg/kg for albino rats and 108 mg/kg for white mice.

This communication contains data on the degree and character of the toxic effect of phthalophos, based on experiments on white mice, albino rats, guinea pigs and cats, using different methods of administration (intragastric, percutaneous and inhalation). For a single intragastric administration, LD_{50} ranged from 92.5 to 164 mg/kg for albino rats and from 26 to 60 mg/kg for white mice and was 200 mg/kg for guinea pigs. A dose of 15 mg/kg was tolerated by albino rats without any visible signs of poisoning, but it inhibited the cholinesterase activity of blood erythrocytes by 20—25%, i.e., it constituted a threshold dose.

The clinical picture of acute poisoning developed within 1 hr after the intragastric administration of lethal doses; it consisted of depression, sluggishness, lachrymation, salivation, increased nasal secretion, dyspnea, fibrillary muscular twitchings and spasms. The animals died within 1 or 2 days.

Repeated intragastric administration of phthalophos to albino rats for 5 months in doses equal to $^1/_{10}$, $^1/_{20}$ and $^1/_{50}$ LD_{50} revealed mild cumulative

properties. The administration of $^1/_{10}$ LD_{50} caused the death of 4 out of 12 rats, the administration of $^1/_{20}$ LD_{50} killed 2 out of 12 rats, and $^1/_{50}$ LD_{50} was not lethal. We investigated the effects of phthalophos on the morphological composition of the blood, the functional state of the albino rats' kidneys and the cholinesterase activity in the organs and blood. The morphological composition of the blood did not exhibit any unidirectional or statistically significant changes. In the long-term experiment there were changes indicating a toxic effect on the functional state of the kidneys, including shift to alkaline urine, an increase of protein, increased glutamic-oxalic transaminase activity in the urine and blood, and an increased concentration of R-nitrogen in the blood. Cholinesterase activity was decreased in the rats' serum, erythrocytes, brain, heart, lungs, liver and kidneys (Figure 1). These changes were directly related to the size of the daily dose.

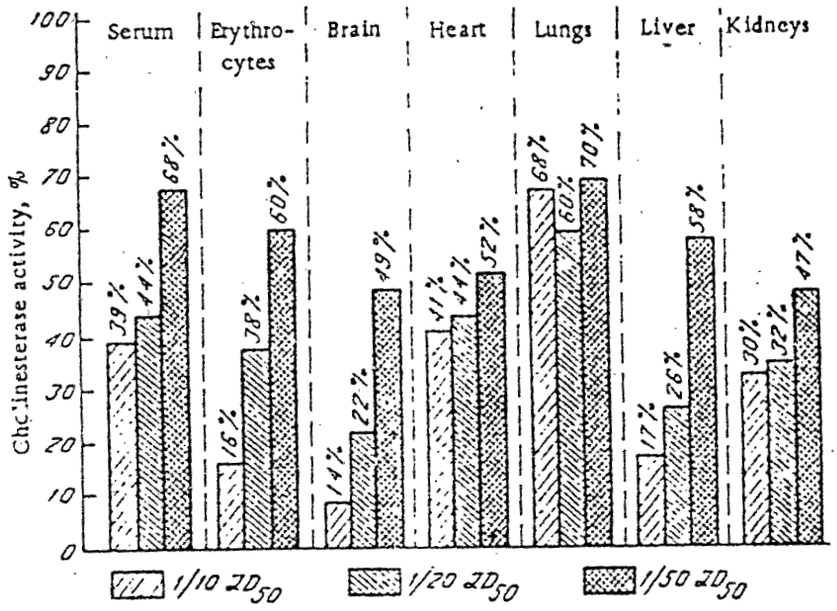

FIGURE 1. Changes in cholinesterase activity in blood and organs of albino rats after repeated administration of phthalophos per os

Pathological effects can often be established not only by biochemical and functional tests but also by pathological investigations.* According to our data, the administration of LD_{100} phthalophos caused a number of clear pathological changes in various organs. There were acute hemodynamic and metabolic disorders, while impairment of the permeability of vascular walls caused the escape of plasma, tissue edema and hemorrhages. Destructive changes included necrosis or vacuolar dystrophy of hepatic cells cells, and the appearance of rarefied areas in the cerebral tissue (Figure 2, a and b). These destructive changes dominated the histological picture. Reactive processes were usually absent, or manifested themselves in polymorphous cellular infiltration of the lungs and myocardium and the proliferation of reticular cells. Daily doses of $^1/_{10}$, $^1/_{20}$ and $^1/_{50}$ LD_{50} in the long-term experiment produced more limited nonspecific changes.

* In our pathological investigations, we received consultatory help from G. A. Rodionov, Candidate of Medical Sciences.

Proliferation of the cells of the hepatic parenchyma, Kupffer's cells and histiocytes were the most common phenomena. There was also proliferation of glia cells and splenic reticular cells.

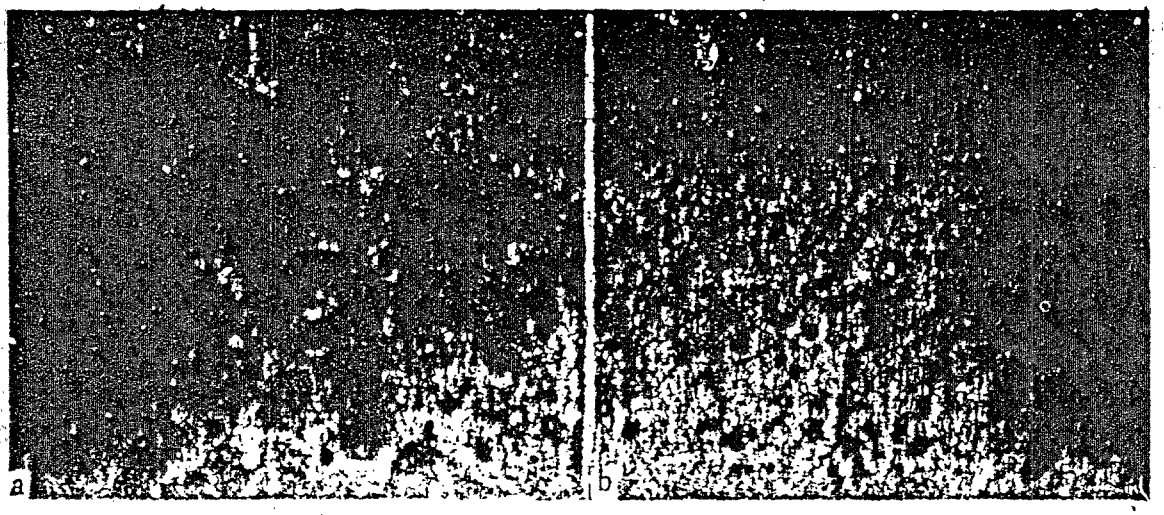

FIGURE 2. Changes in organs following administration of LD_{100}:

a — liver; marked changes in parenchymatous cells, with numerous anuclear cell components and their complexes; hematoxylin-eosin stain, 192×; b — cerebellum; rarefied areas in the cerebral tissue, a focal hemorrhage; hematoxylin-eosin stain, 192×.

Since organophosphorus compounds are capable of penetration through the intact skin, and since this is one of the main paths of entry into the body, we determined the toxicity of phthalophos when applied to the skin of albino rats. LD_{50} for albino rats was found to be 1,700 mg/kg, while I_{50}, i.e., the dose capable of inhibiting the activity of blood cholinesterase to the extent of 50%, was found to be 874 mg/kg. The local reaction of the skin on application of phthalophos manifested itself in transient hyperemia. There were no other visible changes in the skin. Our results indicated a low toxicity of phthalophos when applied to the intact skin, which is important in the practical use of the preparation.

The agricultural application of phthalophos involves the danger of its penetration into the air of the working zone in the form of a liquid aerosol. Its presence in the form of a vapor is less likely, on account of its low volatility. In this connection, we studied the effect of an aqueous emulsion of phthalophos on laboratory animals. The experiments were performed on 138 rats and 12 cats in a chamber for liquid aerosols, with daily exposure for 4 hr. The concentrations of liquid aerosol were produced by atomization of the preparation with a special sprayer (Boitenko). The phthalophos in the chamber air was determined by a thin-layer chromatographic method elaborated by Klisenko and Pis'mennaya in the laboratory of analytical chemistry of pesticides of the All-Union Research Institute of the Hygiene and Toxicology of Pesticides, Polymers and Plastics.

Data on the toxicity of phthalophos following a single exposure by inhalation are listed in Table 1.

It follows from Table 1 that 54 mg/m^3 was the median lethal concentration for albino rats on a single exposure. The concentration of 6.2 mg/m^3

did not affect the animals' general condition, but inhibited cholinesterase activity to the extent of 25%, i.e., this is the threshold concentration. The quantities LD_{50} and I_{25} were calculated by probit analysis according to Prozorovskii. The toxic concentration for cats was 65 mg/m³, while the threshold concentration was 9.7 mg/m³.

TABLE 1. Toxicity of liquid phthalophos aerosol for cats and rats following a single exposure of 4 hr

Phthalophos concentration, mg/m³	Species	Observed effect	Inhibition of blood cholinesterase activity, %	Phthalophos concentration, mg/m³	Species	Observed effect	Inhibition of blood cholinesterase activity, %
20	Rats	No deaths	54.0	4.4	Rats	No signs of poisoning	11.0
31	"	Death of 2 out of 12	61.3	5.4	"	"	26.3
42	"	Death of 4 out of 12	75.5	6.9	"	"	32.1
48	"	Death of 5 out of 12	86.9	9.7	"	"	37.0
65	"	Death of 8 out of 12	86.5				
65	Cats	Death of 1 out of 3	47 – 75	9.7	Cats	"	No inhibition

TABLE 2. Toxicity of liquid phthalophos aerosol for cats and rats on repeated exposure

Mean concentration, mg/m³	Species	Experimental period	Observed effect
16 (17.4 to 14.6)	Rats	35 days	Visible signs of poisoning, inhibition of cholinesterase activity by 29–74% in blood and 62–77% in organs
16 (17.4 to 14.6)	Cats	35 days	Visible signs of poisoning, inhibition of blood cholinesterase activity by 45 – 55%. Death of 1 out of 3 cats
3.1 (3.4 to 2.8)	Rats	4 months	No visible signs of poisoning. Inhibition of cholinesterase activity by 14 – 27%
3.1 (3.4 to 2.8)	Cats	4 months	No visible signs of poisoning. No significant inhibition of blood cholinesterase activity

The toxic properties of phthalophos following repeated daily administration through the respiratory tract was investigated on rats and cats. The air was sampled once in two or three days. Data on the concentration of phthalophos in the chamber were statistically processed to ensure that

the 95 % confidence limits were not trangressed. The toxicity of phthalophos for laboratory animals on repeated exposure is shown in Table 2.

It will be seen from Table 2 that in the long-term experiment a liquid aerosol of phthalophos with a concentration of 16 mg/m^3 caused visible signs of poisoning in the animals and a significant inhibition of cholinesterase activity (toxic concentration). A concentration of 3.1 mg/m^3 caused liminal alterations of blood cholinesterase activity. These results conform with the histological data. The animals exposed to toxic concentrations exhibited dystrophy of the hepatic parenchymatous cells, and increased fluid in the cerebral tissue, with pericellular and perivascular edema and areas of proliferation of glia cells. Histological changes were slight or absent in animals exposed to 3.1 mg/m^3.

The animal experiments were supplemented by studies of the working conditions of workers engaged in the use of phthalophos for the control of orchard pests. The investigations were performed in June 1967 in the "Pobeda" sovkhoz in the Crimean region. Phthalophos was used as a 0.2 % aqueous emulsion. The working solutions were prepared from a 20 % emulsion concentrate and sprayed by a tractor. The air temperature during spraying varied from 21 to 26°C, and air mobility from 0.1 to 2.8 m/sec. The phthalophos concentration in the air of the working zone of the tractor drivers and laborers was 2 — 7 mg/m^3. The persons working with the preparation used personal protective equipment (smocks, gloves, respirators).

The whole blood cholinesterase activity of the workers decreased by 17 — 23 % towards the end of the day, in comparison with its initial level. The workers had no complaints, and we did not discover any changes in the functional state of the vegetative nervous system. Our field results were in agreement with the experimental data.

Thus, in spite of its high toxicity by ingestion, phthalopos has only weak cumulative properties, and belongs to the group of new organophosphorus insecticides (kielval, phencapton, phosalon) that are of low toxicity when applied to the skin, and with a wide range of toxic effect. Therefore, we deem it possible to recommend* that the maximum permissible concentration of phthalophos in the working zone air be set at the level of 0.3 mg/m^3. This concentration is $^1/_{10}$ of the threshold concentration established in the long-term experiment for inhalation by rats and cats, and below the concentration causing threshold changes of cholinesterase activity in human blood.

The results lead to the conclusion that phthalopos is less toxic than thiophos, methylmercaptophos and octamethyltetramide by intragastric administration, skin application and inhalation, and can therefore be recommended in prefence to these other substances.

* This concentration was adopted by the Commission for the Establishment of Maximum Permissible Concentration in the Air of the Working Zone in April 1967.

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SUMMARY

Substantiation of the Maximum Permissible Concentration of Phthalophose in the Air of a Working Zone

L. P. Danilenko

The author studied the toxicity and features of action of phosphororganic insecticide — phthalophose acaricide (imidan, prolat, R-1504) in its administration to laboratory animals by various routes. The substance proved to be highly toxic in its introduction into the stomach and weakly toxic in application onto the skin. Its cumulative properties were insignificant. In introduction by the respiratory route the zone of its toxic action was wide but its toxicity was mild. The toxic effect of phthalophos revealed itself in excitation of the cholinoreactive systems and inhibition of the cholinesterase activity. The maximum permissible concentration of phthalophose in the air of a working zone is recommended to be set at a level of 0.03 mg/m^3.

UDC 615.831.4+615.835.1].015.3(470.23)

ULTRAVIOLET IRRADIATION REGIMEN FOR SUN AND AIR BATHING AT THE LATITUDES OF LENINGRAD AND OREL
(Rezhim ul'trafioletovogo oblucheniya pri prieme solnechnykh i vozdushnykh vann na shirote Leningrade i Orla)

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The natural UV radiation used for curative and preventive purposes must be applied in correct doses, especially to children. Published data on the irradiation regimen for sun and air bathing by adults and children (Spiranskii and Zabludovskaya, and others) are not adequate; they are based on the dosimetric method, which takes account only of thermal